Dr. Ayanna Howard, Task Manager, Telerobotics Research and Applications Group, Jet Propulsion Laboratory

Dr. Howard is an information systems engineer who leads the Telerobotics Research and Applications Group at NASA's Jet Propulsion Lab in Pasadena, CA. The team is developing an intelligent software tool for terrain-based analysis of Mars. She also is the principal investigator on a project to develop a real-time software package for autonomous rover navigation on hazardous terrain.

NASA Tech Briefs: **What are neural networks and how are you using them in your projects?**

Dr. Ayanna Howard: Neural networks are one of the methods we use to give a robot the ability to learn from an experience. It allows you to associate one type of input with another. For instance, we can program a robot to know that if it encounters a four-legged animal that barks, it's a dog. Or, if the four-legged animal meows, it's a cat. Based on the input, we can give the robot parameters on how to deal with what it encounters.

One of the nice things about artificial intelligence is that the applications may change, but you can use a lot of the same techniques. Neural networks are a type of learning tool, so anything that you can learn, you can apply a neural network to. If you have the infrastructure, you may have to tweak things here and there, but the background is so solid that you don't have to re-engineer the entire process.

NTB: You also use a lot of fuzzy logic in your projects. What is fuzzy logic?

Dr. Howard: Everything in the real world is not exact — nothing is 100 percent. We, as people, deal with this all the time. If we're walking and the ground is suddenly uneven, we don't fall — we compensate. Yet, if a robot is walking on flat terrain and suddenly there's a hill, it will fall down because it won't know how to deal with it. The example I like to use is babies. A baby will learn how to walk. But if something drastic happens, and say, it loses a toe, the baby will adapt. Humans use approximation. We don't see a cat and think about the measured physical dimensions of the cat. We say that the cat is big, or small, or fuzzy.

Fuzzy logic takes what humans use — approximation, language, and linguistic-based representation — and applies it in terms of an engineering technology.

NTB: Could any of these artificial intelligence techniques be applied for commercial use in the near future?

Dr. Howard: Manufacturing would definitely be a field where these types of programs could be used. Japan actually uses a lot of fuzzy logic in their plants, so that's definitely a possibility for further use. In fact, right now you have companies trying to do pallet operations where they want the automated forklift to go into a warehouse, find the pallet it needs, lift it up, and take it out to the truck for shipment. That's the type of thing for which you could use neural networks and fuzzy logic, because it is basically the same problem. It actually would be easier because you would know what the warehouse looks like. It would be easier to apply these techniques to known elements and manmade structures than it is to apply it to an unknown environment like the surface of Mars.

NTB: How has the response to this sort of technology changed as it has grown?

Dr. Howard: Interest has grown. People now see the validity of this technology, especially if you want to send an intelligent device into a place where you don't want humans to go. Anywhere that human life might be endangered, you can send something powered by artificial intelligence. Underwater robotics is a good example. We like to send probes down to the bottom of the sea. Due to things like severe pressure, you don't want to send people. You'd send a robot with the same characteristics. Only this time, you have a 3D world instead of a flat plane. That's where fuzzy logic comes in. In terms of the neural networks, because we don't know exactly what it looks like down there, we give the robot the ability to adapt to the situation even if our initial data was incorrect.

A full transcript of this interview appears on-line at ***www.nasatech.com/whoswho****. Dr. Howard can be reached at howard@robotech.jpl.nasa.gov.*